Ruler Drop: The Science of the Catch

Keywords: 2017, Biology, Nerves, Reaction Time, Ruler

Meta Description

This intriguing experiment tests the time it takes for the brain to process what it is seeing into reacting and taking an action.

Learning Objectives

To understand the concept of reaction time, the time taken for an individual to respond to certain stimuli.

To show the presence of a phenomenon known as muscle memory in which repetition of the experiment should result in a faster response time.

Key Terms

Motor neuron

Conducts impulses towards a muscle or gland.

Nerve

Collection of neurons.

Nervous system

A system made up of nerves and neurons which transfers information to and from different parts of the body.

Neuron

Individual cell that conducts nerve impulses.

Reaction time

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How fast the person can react towards a particular stimulus.

Sensory neuron

Transmits information from a sensory organ such as skin towards the central nervous system.

Stimulus

A detectable change in environment.

Method

Step 1

Make your partner sit down, with his/her forearm resting on the table and extending over the edge of the table.

Step 2

Hold the ruler such that your partner holds the ruler vertically near the 30 cm mark.

Step 3

The partner should have their thumb and index finger on either side of the 0 cm mark.

Step 4

Allow the partner to practice holding the ruler with the index and thumb.

Step 5

The partner should now be ready to start the experiment, and the partner should once again have their thumb and the index finger on either side of the 0 cm mark. Make sure that their fingers are not touching the ruler.

Step 6

Without warning release the ruler making sure that you release the ruler vertically and not horizontally.

Step 7

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Record the level just above the partner's thumb where the ruler was caught.

Step 8

Repeat the experiment and tabulate the results to make it easier to compare any change in response time.

Step 9

It might be necessary to give your partner some rest between experiments, as if the partner gets tired the response time will increase.

Alternative Method

Use a string to hold the ruler instead of using your hands (this is actually an improvement upon the experiment as it ensures that the ruler is dropped vertically rather than diagonally).

Precautions

1. Use a wooden/plastic ruler rather than a metal ruler just in case it drops on the volunteer`s foot which can be rather painful.

Narrative

Imagine you are the owner of a Formula One car which can reach speeds of up to 380 km/h. Now further imagine that you are driving this powerful car in the countryside and out of nowhere a herd of cows appears grazing not far from you. Could you respond to this event and taking the appropriate action to avoid hitting the innocent cows? We are going to test this by measuring your reaction time that is the time taken for you to notice the cows (ruler falling) and the time taken to brake/move around the cows (catching the ruler).

Questions

What are some factors which could affect your reaction time?

Age, alertness and gender are such factors.

Why did the reaction time decrease following the first trial?

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Muscle memory.

What are stimuli?

Any detectable changes in environment – in this case, the falling ruler.

How can you decrease your reaction time?

By practicing the activity over and over.

Does the dominant hand have a faster reaction time?

Yes.

How does alcohol affect your reaction time?

Increases reaction time.

Brief Explanation

The nervous system consists of the brain, the spinal cord and nerves which can communicate with each other to co-ordinate all of your**actions and reactions**.

The sequence of events occurring during the time at which the ruler was falling:

1. Seeing the ruler with your eyes (otherwise known as visual information)
2. This visual information is passed on towards the brain
3. The brain sends information to the spinal cord
4. The spinal cord sends information to the muscles of your fingers
5. You close your so that you can catch the rule

Detailed Explanation

The sequence of events occurring during the time at which the ruler was falling can be summarized in more detail by the following steps:

1. You see the ruler with your eyes and pass the visual information towards the visual cortex.
2. The message is then passed towards the motor cortex.
3. The motor cortex sends impulses down the spinal cord.
4. The information passes towards the muscles found in the fingers.
5. The muscles in the fingers contract, allowing you to catch the ruler and preventing it from falling on your foot (which can be rather painful).

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<<picture>>

The model for information flow can be illustrated as follows:

Stimulus ? Sensory neuron (convert external stimuli obtained from the external environment into internal electrical impulses – carry information from the sense organs) ? Spinal cord/Brain ? Motor neuron ? Appropriate Response

Faster responses are generated when the information is processed in the spinal cord rather than the brain due to a shorter distance. The spinal cord is capable of perceiving simple reflex actions which allow for a quick response. A common example of a simple reflex action is the knee jerk. However, when a more complex response is involved such as catching a falling ruler, the brain has to be involved.

The reaction time was measured in this experiment, which is how fast the person can react towards a particular stimulus such as a falling ruler. The reaction times tend to decrease with practice this is known as repetition priming. Fast reaction times are what allows you to win races while slow reaction times can lead to disastrous consequences such as driving accidents.

Applications and Research

The driver reaction time can be used in crash avoidance research. This research utilizes driving simulators in order to test the reaction time of drivers.

A research carried out in India during the year of 2016 put a light on the distraction effects that can be caused by using a mobile phone whilst driving.

Investigation

- Reaction times are known to change with age. Test this by using volunteers of different ages such as for example a 5 year old, a 40 year old and an 80 year old.
- Test another factor that can affect response time; see if there is a difference between response times when using your non-dominant hand rather than your dominant hand.
- Another variable that can be tested is the difference in the response time of different genders. An important factor to keep in mind is that all the other variables are to be kept constant, that is both the male and female should have had same amount of sleep, same age etc.

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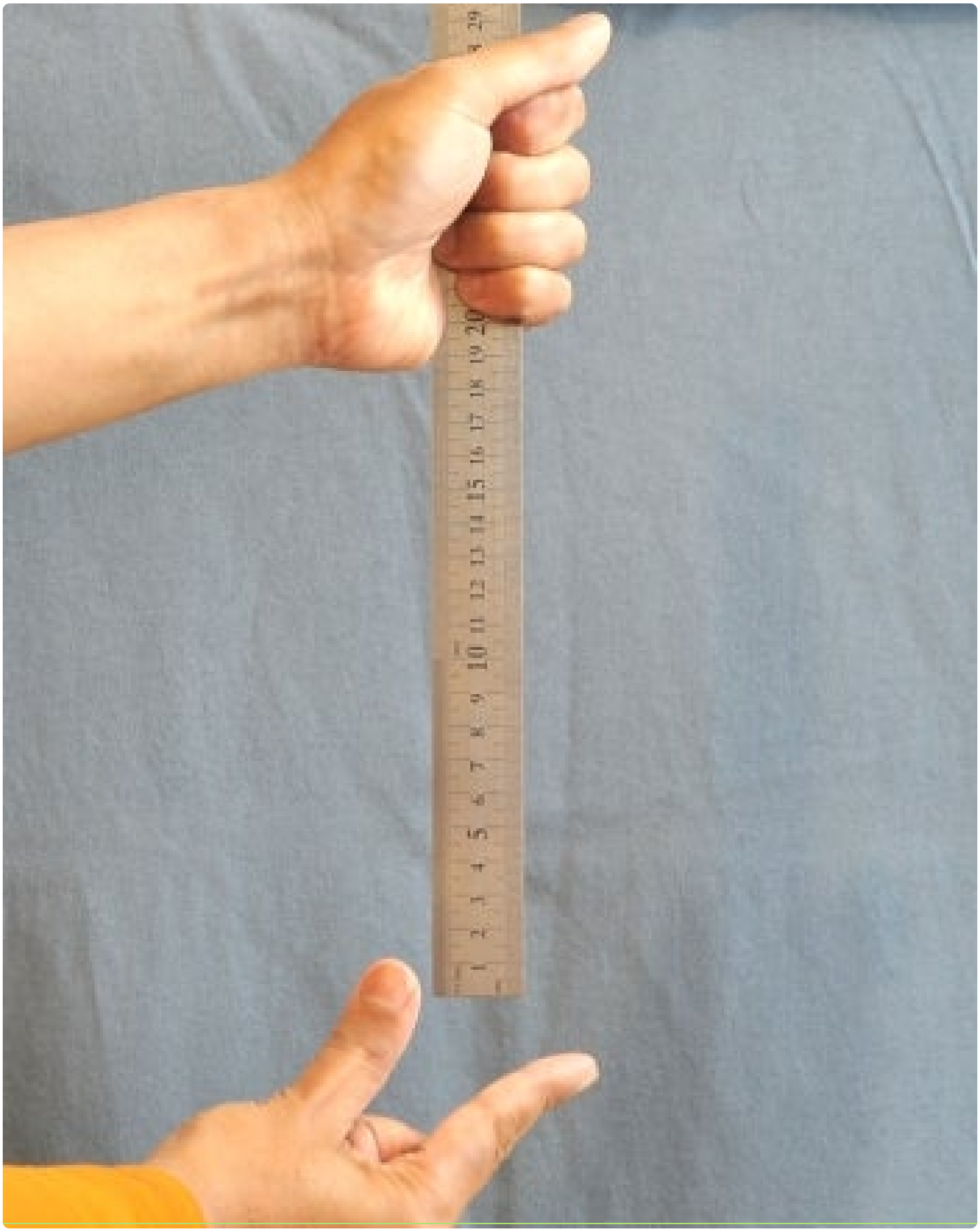
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Subject

Biology

Education

Secondary
Post Secondary

Time Required

~45 minutes
Preparation: 5 minutes
Conducting: 30 minutes
Clean Up: 5 minutes

Cost

0 – 10 €

Recommended Age

6 – 9
10 – 12
13 – 16

Number of People

2 participants

Supervision

Not Required

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Location

Indoors
Outdoors
Festivals
Laboratory

Materials

Ruler

Table and Chair

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Sources

Response time research.

Reaction Time Ruler

Reaction Time: “Catch a Ruler”

Your Nervous System

Reaction Time: The Ruler Drop Test

Cite this Experiment

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